PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Richard R. Dickson et al. Application No.: Unassigned Filed: July 10, 2001 For: EXHAUST GAS PARTICULATE MEASURING SYSTEM Attorney Docket No. 00-714	Art Unit: Examiner:	Unassigned Unassigned

Peoria, Illinois 61629-6490

Assistant Commissioner for Patents
Washington, D.C. 20231

AMENDMENT

Sir:

Please amend the above-identified application as follows:

IN THE SPECIFICATION

Please add paragraphs to the specification after paragraph 5 and before the heading Brief Description of the Drawings on page 3 as follows:

Summary of the Invention

In one aspect of the present invention, a transient dilution air control arrangement for controlling a dilution air supply to a partial flow dilution tunnel of a gas sampling system is provided. The partial flow dilution tunnel is connected to an exhaust pipe of an internal combustion engine. The gas sampling system has a first mass flow controller operatively connected to an inlet of the partial flow dilution tunnel, a second mass flow controller connected to an outlet end of the partial flow dilution tunnel and a filter interposed

the second mass flow controller and the outlet end of the partial flow dilution tunnel. The transient dilution control arrangement includes a constant mass flow stream connected to the input of the partial flow dilution tunnel and a variable mass flow stream connected to the constant mass flow stream.

In yet another aspect of the present invention, a gas sampling system for measuring particulate matter in an exhaust gas stream of an internal combustion engine is provided. The gas sampling system includes a partial flow dilution tunnel connected to the exhaust gas stream of the engine. A first mass flow controller is operatively connected to an inlet of the partial flow dilution tunnel. A second mass flow controller is connected to an outlet end of the partial flow dilution tunnel. A transient dilution air control arrangement is interposed the first mass flow controller and the inlet of the partial flow dilution tunnel and controls a dilution air supply to the partial flow dilution tunnel

Please amend paragraph 12 of the specification as follows:

A laminar flow element 20 or other flow device is positioned in conduit 13 between the filter 18 and the engine 16. Laminar flow element 20 is a pressure differential flow element located to measure the flow of intake air 14 to engine 16. Laminar flow element 20 is connected to an airflow rate transducer enclosure 22. Located in the enclosure 22 is a pressure differential transducer 24 that converts the pressure differential across laminar flow element 20 into, for example a 0 – 5Vdc or other suitable range such as 0 – 10Vdc, an analog signal output that is transmitted through conductor 26 for use as will be described later. It should be understood that the arrangement described above is for exemplary purposes and a non-linear measurement device such as a Brandt Air Flow Meter can be used if a linearizing algorithm is used or any other flow measurement system that produces a voltage output linear to flow rate is applicable. Also the test cell 10 shows an internal combustion engine 16 having only a single turbo charger. However, in the event that an engine 16 having a dual or quad turbo charger arrangement (not shown) is to be tested the supply of intake air 14 will be separated into two or four paths respectively, each of which will contain a laminar flow element 20 up stream of each turbo charger.

Please amend paragraph 18 of the specification as follows:

As shown in Fig. 2 the previous system taught in U.S. Patent 5,058,440, an air flow rate meter (AM) 94, such as a laminar flow element or a Brandt flow meter, which measures the rate of incoming air supplied to the engine 16 to be sampled. Also, a fuel flow rate meter (FM) 96 is provided to measure the rate of fuel being instantaneously supplied to the engine. The air flow rate meter 94 has a signal line 98 that is connected to a signal conditioner 100, and the fuel flow rate meter 96 has a signal line 102 connected also to the signal conditioner. The signal conditioner 100 preferably has two programmable electronic processing units therein, although not shown. One of these units is adaptable to convert the voltage signal in signal line 98 by a first preprogrammed rate table to an electrical signal in a first outlet line 104 to microprocessor (PR) 84, and the other unit is adaptable to convert the frequency signal in signal line 102 by a second pre-programmed rate table to an electrical signal in a second outlet line 106 to microprocessor 84.

Please amend paragraph 21 of the specification as follows:

As seen in Fig. 3 and shown in detail in Fig. 4, a selectable gain circuit 140 is connected to the voltage to pressure controller 130 via conductor 160. The selectable gain circuit 140 is an analog refining circuit that receives an electrical input signal proportional to the mass flow rate of the intake air through conductor 26 from the pressure differential transducer 24. The analog signal from the pressure differential transducer 24 is received at a first input connection 142. In the event of a dual intake path for a dual turbo charged internal combustion engine 16 a second input connection 144 is provided. A switch 146 provides that the circuit 140 can be toggled between an open position for a single channel input or closed to average a dual channel input. A selectable gain switch 150 is selectable between a plurality of coarse voltage positions 152, for example from 0 – 5Vdc maximum position to 0 – 1.67Vdc minimum position, based on the amount of intake air or particular size of engine 16 for a given test, potentiometer 154 is used to fine tune the signal thereafter. A remaining portion 156 of circuit 140 refines the analog signal in a conventional manner with an output

connection 158 supplying the analog signal to the voltage to pressure controller 130 via conductor 160. The selectable gain circuit 140 can be manually operated or can by controlled by the microprocessor 84.

Please amend paragraph 23 of the specification as follows:

In operation, solenoid valves 66,68,70,78 and 81 are open/closed type valves that are used for many purposes, which are apparent by an inspection of Fig. 2, such as at start up and by pass mode so that the vacuum pump 82 is not damaged. Solenoid valve 79 is included to provide a calibration loop, which by shunting the system, places the slave mass flow controller (MFC1) 60 and the master mass flow controller (MFC2) 80 directly in series with one another.

Please amend paragraph 24 of the specification as follows:

The gas sampling system shown in Figs 1 and 2 uses capillary tube-type thermal mass flow controllers 60 and 80 are electrically driven by the microprocessor 84. The processor 84 controls the total air flow rate to the partial flow dilution tunnel 38 that is capable of re-acting to transient engine conditions while substantially eliminating particle deposition and entrainment. For example, the ratio-establishing processor 84 can apportion the control signals in the lines 86 and 88 to the master mass flow controller 80, and the control signals in the lines 90 and 92 to the lesser flow capacity slave mass flow controller 60 to establish an approximate ratio of flow of about 1.1 to 1.0, yielding a typical dilution ratio of about 10:1. This value should be controllable and variable.

Please amend paragraph 25 of the specification as follows:

Transient conditions are corrected for by the laminar flow element 20 the selectable gain circuit 140 and the transient dilution air control arrangement 110. Specifically, during a transient testing operation the laminar flow element 20 measures